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ABSTRACT

National estimates of school achievement as measured by the reading and arithmetic subtests of the Wide Range Achievement Test (WRAT) for the noninstitutionalized population of the United States aged 12-17 years are presented. Data were obtained in the Health Examination Survey (HES) of 1966-70. In the survey a probability sample of 7,514 youths was selected to represent the 23 million adolescents aged 12-17 years residing in this country. Test results were presented by age, sex, and educational level in their raw score form to permit comparison with other studies using the WRAT. Percentile ranks and normalized standard score (T Score) equivalents of the raw scores have been included. The Cycle III HES data demonstrated a continued development of reading and arithmetic skills through the adolescent years and as formal education increased. Girls in the age range surveyed performed better than boys on the word recognition and pronunciation task presented by the WRAT. A similar finding came from HES Cycle II program when the Level I reading of the WRAT was administered to children 6-11 years old. No significant differences between boys and girls in arithmetic computational skills were found in either survey. (Author/BJG)

Data from the
NATIONAL HEALTH SURVEY

Series 11
Number 136

Reading and Arithmetic Achievement Among Youths 12-17 Years

as Measured by the Wide Range Achievement Test

United States

Findings from the reading and arithmetic subtests of the Wide Range Achievement Test, administered in a national survey of youths in 1966-70.

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DIVISION OF HEALTH EXAMINATION STATISTICS

COOPERATION OF THE BUREAU OF THE CENSUS

In accordance with specifications established by the National Health Survey, the Bureau of the Census, under a contractual agreement, participated in the design and selection of the sample, and carried out the first stage of the field interviewing and certain parts of the statistical processing.

Vital and Health Statistics-Series 11-No. 136

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SYMBOLS

Data not available	---
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READING AND ARITHMETIC ACHIEVEMENT AMONG YOUTHS 12-17 YEARS

AS MEASURED BY THE WIDE RANGE ACHIEVEMENT TEST

Dale C. Hitchcock and Glenn D. Pinder, *Division of Health Examination Statistics*

INTRODUCTION

This report presents information on the levels achieved in reading and arithmetic, as measured by the Wide Range Achievement Test, by U.S. youths aged 12-17. The data were obtained in the Health Examination Survey that was conducted from March 1966 to March 1970 by the National Center for Health Statistics. Information presented here is essentially a continuation of that reported in a previous publication for children ages 6-11.[1] The present report is limited to presentation of the findings on adolescents by sex, age, and grade in school (appendix I).

The Health Examination Survey (HES) is an ongoing program which collects data by direct examination of representative samples of the noninstitutionalized population of the United States. Since 1960 the survey has conducted a series of separate programs (called "cycles") concerned with segments of the total population and focused on certain aspects of the health of the selected subpopulation. The data in this report were obtained during Cycle III, in which youths aged 12-17 were examined. That program was a continuation of the immediately preceding cycle, in which children aged 6-11 years were given an examination which focused on health factors related to growth and development. Details regarding the surveys can be obtained in comprehensive reports on the children's program[2] and the youths' program.[3] Further information about the Cycle III survey design is presented in appendix II.

A standardized single-visit examination was given each youth by an examining team in a specially designed mobile unit. Along with examinations by a physician and dentist and a variety of tests and measurements performed by technicians, a 70-minute psychological test battery was given by a psychologist. The battery included the following procedures, which were administered in the order listed: Wide Range Achievement Test, arithmetic and reading sections; Wechsler Intelligence Scale for Children, vocabulary and block design subtests; a five-card, tape-recorded version of the Thematic Apperception Test; a modified version of the Goodenough-Harris Drawing Test; the Brief Test of Literacy; and a self-administered questionnaire concerning the youth's attitude and behavior relating to certain aspects of health. A critical evaluation of most of the psychological tests used in the survey, including a literature review of previous research and evaluations, was made by S. B. Sells of Texas Christian University. The results of the evaluation were published in the Center's methodological reports series.[4]

Before sample youths were examined, information was obtained from their parents. The information included demographic and socioeconomic data on household members as well as a medical history and behavioral data about the sample youth. Information regarding per-

formance and adjustment was requested in a questionnaire sent to the youth's school. All information was collected under a guarantee of strict confidentiality.

Of the 7,514 youths composing the sample, 6,768 (90 percent) were examined. Because of the sample design, adjustment for nonresponse, and weighting procedures, examination results can be considered representative of the approximately 23 million noninstitutionalized youths 12-17 years of age in the United States at the time of the survey. Sampling errors associated with estimates in this report are presented in appendix I.

THE WIDE RANGE ACHIEVEMENT TEST

When plans were made to conduct a health survey of the U.S. population from ages 6 through 17, it was decided that an assessment of educational achievement would be relevant since many developmental and psychological problems first come to the attention of teachers, physicians, parents, and others as "learning" or "school" problems. Although less widely known and used than some comprehensive achievement test batteries, the Wide Range Achievement Test (WRAT) met the survey's requirements of both brevity and applicability to the entire age range of the target population. The choice was supported by published data and by the opinions of some clinicians to the effect that the WRAT could be accepted as a good predictor of performance on the more traditional achievement tests.[4]

The WRAT was developed in 1936 by Jastak and Bijou as a tool for studying achievement in the basic school subjects of reading (word recognition and pronunciation), written spelling, and arithmetic computation. The first edition and a revision in 1946[5] had only one scale of achievement, which ranged from kindergarten to college for each of the three subtests. The 1965 edition[a] retained these three subtests, but each was represented by separate scales at two levels.[6] Level I was designed for children between the ages of 5 years 0 months and 11 years 11 months, while Level II was intended for persons from 12 years 0 months to adulthood. At both levels, the reading subtest consists of recognizing and naming letters and pronouncing words arranged in order of increasing difficulty; the spelling section involves copying marks that resemble letters, writing one's name, and writing single words as they are dictated; and the arithmetic subtest requires counting, reading number symbols, solving oral problems, and performing written computations normally taught in schools. Jastak provided tables for converting raw scores on the three subtests to grade equivalents, percentiles, and standard scores.

Because of time limitations, only the reading and arithmetic subtests of the WRAT were given during the survey of youths. Further discussion of the WRAT and the survey findings presented below has been limited to those two subtests.

Adequate validity data on the WRAT are not presented in the manual for the 1965 revision. Findings based on limited study of the 1946 version are repeated from the 1946 manual; they suggest that WRAT results are closely related to scores on the New Stanford Achievement Test. Product-moment coefficients for samples of 7th and 8th graders are reported as follows: WRAT reading with New Stanford Paragraph Reading, .81 (N=389); WRAT reading with New Stanford Word Reading, .84; WRAT arithmetic with New Stanford Arithmetic, .91 (N=140). The 1965 manual also includes some data on reliability of the WRAT.[6] From a sample of 200 individuals selected to represent a typical distribution of achievement, split-half reliability coefficients were calculated for the reading and arithmetic subtests. The split-half measures used were scores on the odd-even items arranged in order of difficulty. Correlations for age groups 12 and older for both subtests were all above .95. As a measure of test-retest reliability, Jastak[6] cited a study in which a group of 77 retarded persons, ranging in age from 15 to 17 years, were given the WRAT (along with other tests) five times within a 3-week period. The WRAT scores were found to be very stable, showing the smallest variations of all the tests included.

[a] In the previous report on the WRAT findings in the HES children's program,[2] it was reported that a 1963 revision was used. This was a provisional edition eventually published as the 1965 revision with only slight changes in the word order of the reading subtest. The 1963 provisional editions of the reading and arithmetic subtests were used in the survey of youths.

To further study the use of the WRAT as a measure of school achievement, the National Center for Health Statistics contracted with K. Warner Schaie of West Virginia University for a special validation study. The complete findings of that study have been published.[7] A summary of Schaie's findings regarding adolescents with some brief remarks regarding several other relevant studies follows.

Schaie's study was designed to assess the adequacy of the WRAT to predict actual grade placement and to estimate achievement as measured by another comprehensive battery. Level II of the WRAT was administered to 314 boys and 319 girls attending secondary schools in Monongalia County, West Virginia. The sample consisted of approximately equal numbers of youths in grades 7 through 12. To assess the possibility of regional bi an additional sample of 596 subjects was selected from the 7th and 10th grades in Milwaukee County, Wisconsin, the 8th and 11th grades in Los Angeles, California, and the 9th and 12th grades in Fort Collins, Colorado. The Stanford Achievement Test (SAT) was administered to the junior high school students (grades 7-9) and the Metropolitan Achievement Tests (MAT) were given to students in senior high school. In the junior high population reasonably good concurrent validity was demonstrated by the correlation of WRAT scores with those on the appropriate subtests of the SAT. Among the three grade levels and the geographic regions the coefficients ranged from .66 to .84 for arithmetic and from .47 to .80 for reading. Likewise the high correlation of the appropriate sections of the MAT with the two WRAT subtests for the senior high school group further supported the validity of the WRAT. These validity coefficients ranged from .62 to .82 for arithmetic and from .49 to .82 for reading. Schaie concluded that, while there is a considerable range in the magnitude of validity coefficients depending on level and geographic region involved, there is sufficient evidence of substantial correlation with criterion measures at every age level investigated to consider the WRAT a satisfactory brief instrument for estimating school achievement.

In estimating grade level placement, the WRAT was found to vary considerably, ranging from close agreement to wide disagreement with the various criteria applied. Level II tended to underestimate actual grade level, but it rather accurately predicted achievement levels on the SAT and MAT arithmetic-related subtests. The WRAT Level II reading test overestimated the actual grade level of junior high students but underestimated that of senior high students. Performance on the SAT was underestimated, while performance on the MAT criterion variables was overestimated.

The latest edition of Buros' *Mental Measurements Yearbook*[8] lists 64 references on the WRAT which have been published since it was first issued in 1936. The length of this list attests to a more than narrow or limited interest in the test, but a review of the articles reveals that many have dealt with applications involving small and special populations. For example, one recent study[9] suggests that the WRAT and the California Achievement Tests (CAT) are highly correlated when used with preschool children and early elementary school children. A median correlation of .80 among all the subtests, with a high of .89 between WRAT reading and total CAT score, is reported for a sample of 96 children. Another study,[10] again comparing the WRAT and CAT, is more relevant to the present report because the 98 test subjects were 7th grade students. Correlation coefficients between WRAT and total California reading and arithmetic scores are reported to be .73 and .80, respectively. At least 20 of the 64 references cited in Buros dealt with samples of retarded persons. A brief report of a 1962 study[11] illustrates the use of the WRAT in such studies of mentally retarded subjects. When the WRAT scores and MAT scores of 25 institutionalized boys (ages 9-14) were compared, rank order correlation coefficients were .87 for arithmetic and .76 for reading. Another study[12] that illustrates the wide use of the WRAT with mentally retarded persons also exemplifies a common procedure initiated by Jastak, that of comparing WRAT scores with intelligence test findings. For the test results of 72 mentally retarded males aged 16-35, correlation of WRAT scores with Stanford-Binet and Wechsler Adult Intelligence Scale scores ranged from .47 to .78.

Although the foregoing comments are not

presented as a comprehensive review of the literature on the WRAT, the studies cited are representative of the evidence that supports the reliability and validity of the two WRAT subtests for the purposes of HES Cycle III.

FIELD TESTING PROCEDURES

The WRAT subtests were administered during individual testing sessions conducted by psychologists who had at least a master's degree and who had experience in test administration. There were two psychologists on the examining team at all times. The examiners were trained in the special HES testing procedures and supervised by the advisory staff of the survey. During the training and supervision, strong emphasis was placed on uniform methods of test administration, scoring, and recording of data. Throughout this survey of adolescents 12 psychologists worked in the field.

The arithmetic and reading subtests were the first procedures administered in each testing session. They were given in accordance with the WRAT Manual for the 1965 revised edition,[6] with certain minor modifications to conform with special forms and practices of the survey. Only Level II tests were used, since all sample youths were 12 years old or older.

Both tests were printed on the same two-page form in a format identical to Jastak's standard form. The arithmetic section was on one page, which contained the 46 problems of the written part and 15 dots and five numbers. The dots and numbers along with three orally presented word problems compose the oral arithmetic test. The opposing page had space for computation. The page of arithmetic problems was shown to each youth, and he or she was asked to work in 10 minutes as many problems as possible. If the youth did not correctly complete at least six problems within the allotted time, the oral part of the subtest was given. In the oral part the youth was asked to count aloud the 15 dots on the form, to read the five numbers, and to solve three simple word problems. These tasks were worth 10 points, one point for counting five dots correctly, another point for counting six through 15 dots, one point for reading each number, and one for solving each problem. If the youth obtained a score of six or more (one point for each problem) on the written problems, the 10-point credit was given for the oral part. The highest possible raw score for the arithmetic subtest is 56 points.

The reading test consists of 13 capital letters and 76 words which are printed on one page in order of increasing difficulty. A laminated copy of this sheet was presented to the youth, who was instructed to read aloud each of the words in the sequence in which they appeared. On another test form (the one on which the youth had done the arithmetic), the examiner checked off each word that was incorrectly pronounced until 12 consecutive words were missed. On the first mispronunciation of any one word, the youth was asked to repeat the word, but from then on the first response or spontaneously changed response was scored. Approximately 10 seconds were allowed for each word, with the examiner controlling the speed by saying "next" or "go on to the next word." If the youth failed to score at least six points on the word pronunciation (one point for each correct word), he or she was asked to read aloud the 13 capital letters and to read the first two letters in his or her name after writing it on the test form. The letter reading was worth a total of 15 points. Anyone obtaining a score of 11 or more on the word pronunciation was credited with the 15 points for the letters. A possible maximum 89 points can be earned on the reading test. The verbatim instructions used by the examiners for the arithmetic and reading subtests are included in appendix III.

The examiner recorded all right and wrong answers on each test in specified spaces on the test form. Scores were computed and recorded on the front of the form. As part of the comprehensive quality control practices of the survey, the two psychologists daily exchanged all test forms and checked each other's work for apparent errors in administration or recording.

Once a week an entire testing session was recorded on tape by each field psychologist. A transcription of the taped session was reviewed by a psychologist at headquarters, who noted errors, commented on testing procedures if necessary, and then returned the transcripts to the examiners.

RESULTS

Reading Subtest—Raw Scores

On the reading subtest of the Wide Range Achievement Test, youths 12-17 years of age in the noninstitutionalized population of the United States attained a mean raw score of 48.5 points out of a possible 89 points (table 1). The mean reading score increased steadily with age, rising from 42.1 points at 12 years to 53.7 at 17 years (figure 1 and table 1). Mean scores for half-year age intervals are also presented as a more precise reflection of the growth patterns in school achievement as measured by the WRAT. Gradually increasing mean scores also occurred among the 6-month age groups (table 2). The variability as indicated by the standard deviations for each of the 6-month age groups tended to increase with age, although not consistently. The relative variation among the reading test scores was, however, quite constant throughout the age range. This was determined by computing coefficients of variation which allow comparisons of dispersions of scores in different series where the means vary.

As indicated in table 1 and figure 2, mean scores increased steadily as the amount of education increased, rising from 42.6 in the 7th grade to 58.7 in the 12th. The increasing scores from one grade level to the next can be observed for youths at every single year of age. Within the appropriate grade range for the population (grades 7-12), there was a fairly consistent increase of around three points from grade to grade. Those youths who were in grades below the expected level for the ages of this population performed substantially poorer. The mean score of 6th graders was 6.4 points below that of 7th graders; the mean score of 5th graders was 8.3 points below that of the 6th graders.

High school graduates obtained about the same scores as those in the 12th grade. Youths who continued or planned to continue their formal education beyond high school obtained substantially higher scores than those who did not. This difference probably reflects a phenomenon of selection, wherein persons of greater ability continue their education, while those with less ability do not.

A few other observations regarding the data in table 1 may be of interest. The youths, mostly 16- and 17-year-olds, who had left school before graduating, that is, the small group of school dropouts, generally achieved scores on the reading test comparable to those observed in the 6th and 7th grades. The group of youths designated as being in some kind of special class had a mean score of 23.1, lower than the scores of all educational placement categories except that of grade 4 and below. This relatively small

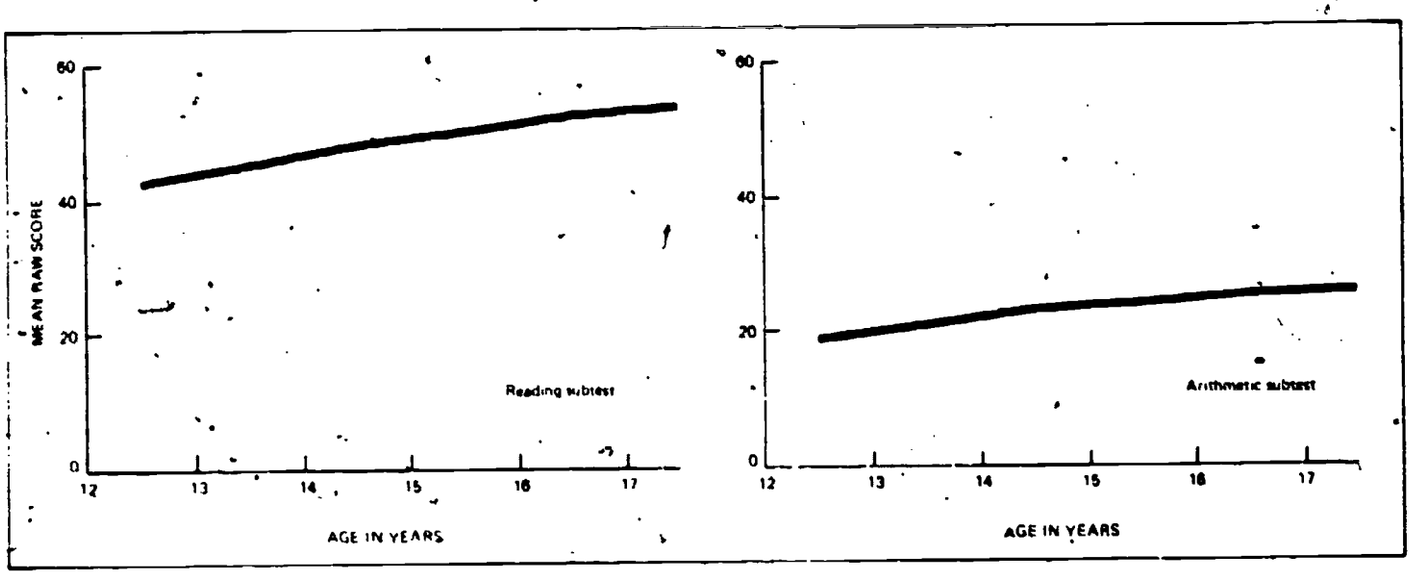

Figure 1. Mean raw scores on the reading and arithmetic subtests of the Wide Range Achievement Test for youths, by age: United States, 1966-70

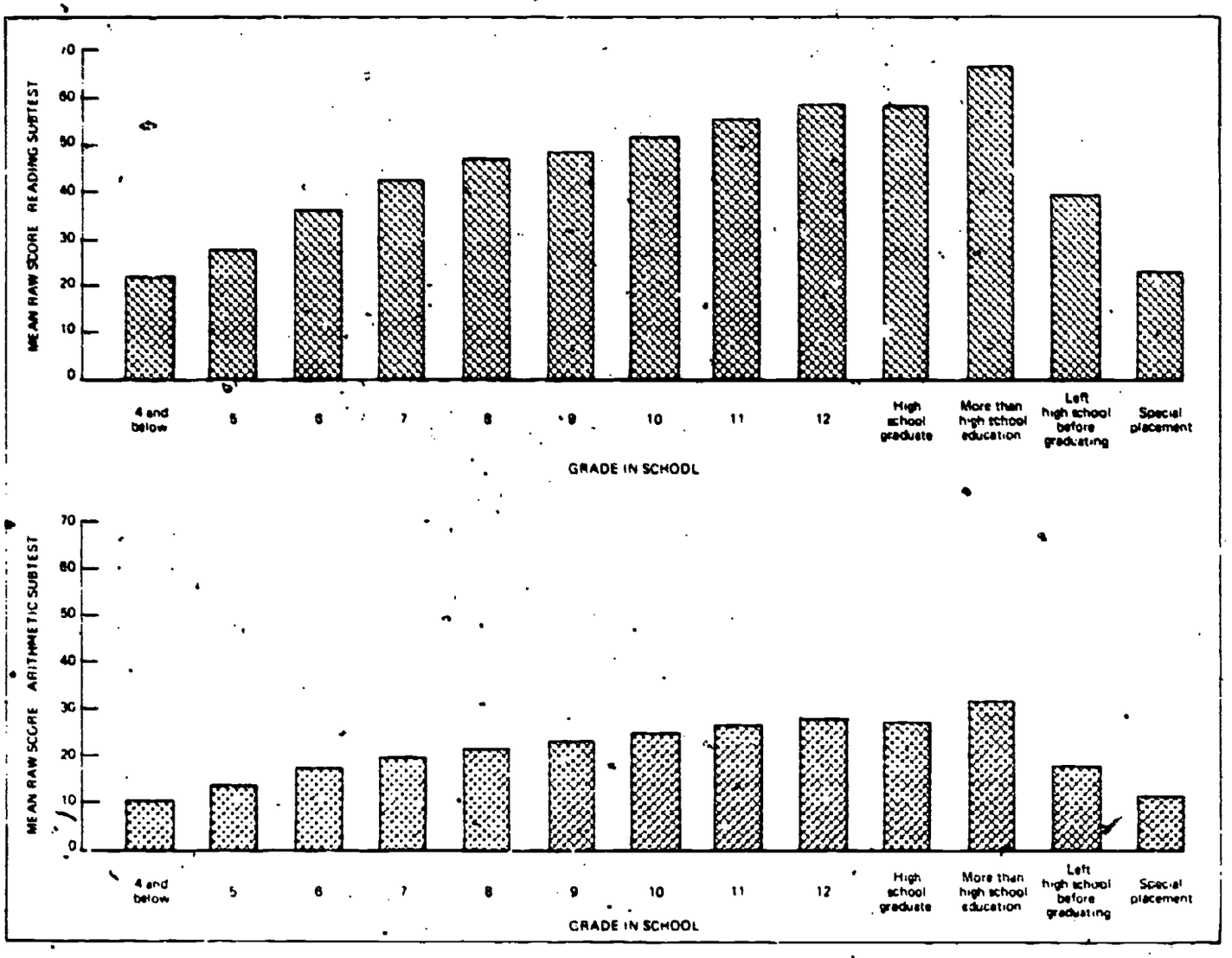

Figure 2. Mean raw scores on the reading and arithmetic subtests of the Wide Range Achievement Test for youths 12-17 years of age, by grade in school: United States, 1966-70.

group included individuals with major reading problems, many complicated with serious mental and physical handicaps. In observing the relationship between age and grade, it can be seen that mean scores of youths in the usual grade for persons of their age were higher than scores for those who were older and a little lower than those of youths who were younger. This finding is expected since it is a reasonable assumption that persons who are permitted to skip grades are generally more advanced than the average and that those who are retained in a grade are slow learners or at least slower.

Girls performed better than boys on the reading subtest, averaging 2.5 raw score points higher. Higher scores were achieved by the girls at all ages, with differences being significant in all but the 13- and 15-year-old groups (figure 3 and table 1). Among those youths in school and within the appropriate grade range for the population, boys again obtained lower reading scores than did girls at every grade level (figure 4 and table 1). These differences averaged about two points but only for the 9th and 10th grades were the differences significantly different.

Variability of the reading subtest raw scores was consistently greater for boys than for girls in all half-year age groups except for the 17 1/2-year-olds. The differences were significant in all but five of the groups (all 12- and 16-year-olds and the 15 1/2-year-old group). The girls exhibited significantly more variability than did boys in the 17 1/2-year-old group (table 2).

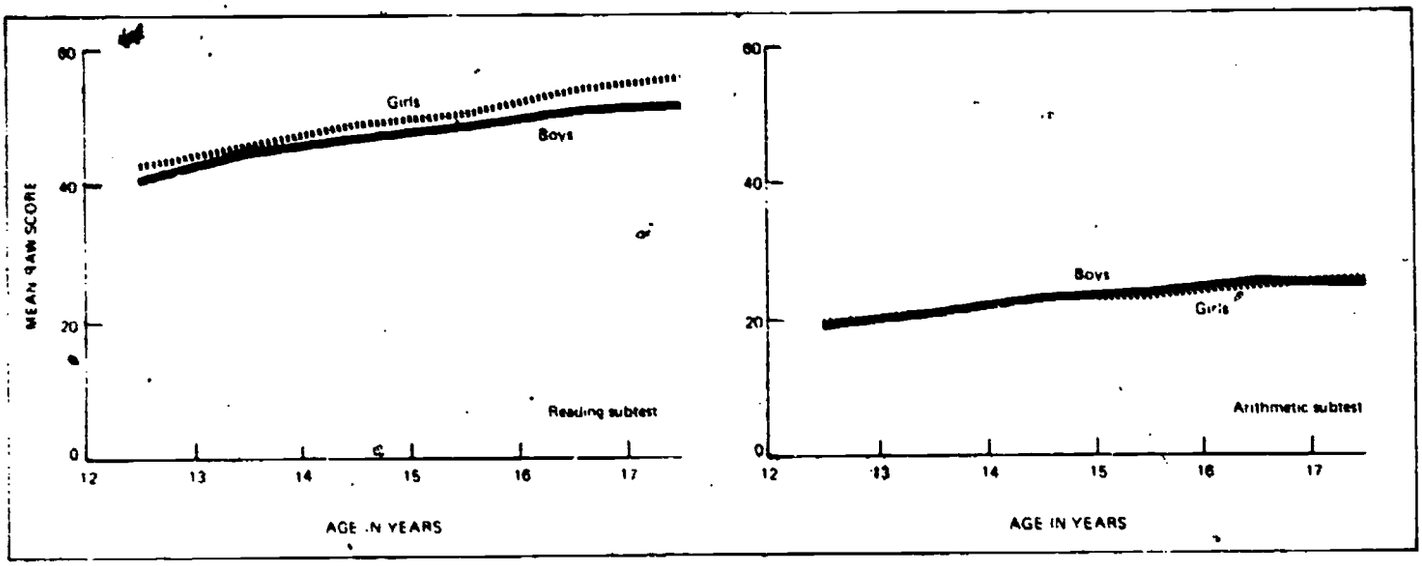

Figure 3. Mean raw scores on the reading and arithmetic subtests of the Wide Range Achievement Test for boys and girls, by age: United States, 1966-70.

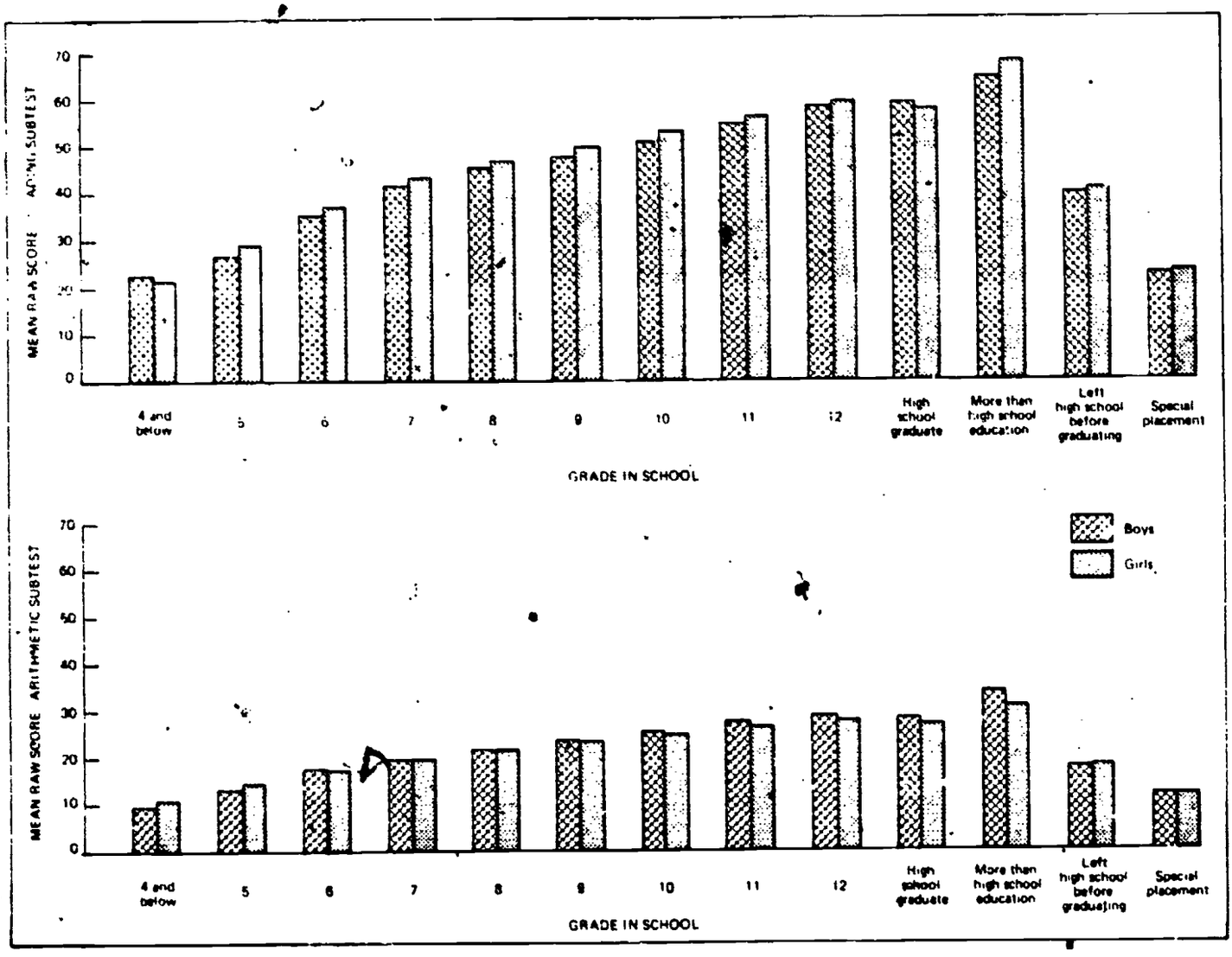

Figure 4. Mean raw scores on the reading and arithmetic subtests of the Wide Range Achievement Test for boys and girls 12-17 years of age, by grade in school: United States, 1966-70.

Arithmetic Subtest—Raw Scores

Youths 12-17 years of age in the noninstitutionalized population of the United States had a mean of 23.0 raw score points out of a possible 56 points on the arithmetic subtest of the WRAT (table 3).

The mean raw score increased slightly with age through age 16 and then leveled off (figure 1 and table 3). Mean scores are also reported for half-year age groups, and a gradual increase can again be observed from one age group to the next (table 4). The variability as indicated by the standard deviations for each half-year age group also increased slightly with age. As on the reading subtest, the relative variation among the arithmetic scores was generally constant over all age levels (table 4).

A steady increase in mean scores, reflecting increasing skill in arithmetic computation, may be seen throughout the grade range. The mean raw scores for grades 7 through 12, the appropriate range of grades for this population, increased from 19.6 to 28.1 (figure 2 and table 3). Increases from one grade to the next can be seen within each single year of age. Observations regarding other grade placement categories are similar to those made about the reading subtest. Youths in grade 6 and under had lower scores than those in the 7th grade and over. Means for the 5th and 6th grades, however, were within the same gradually increasing progression, rather than substantially lower than those obtained by youths in the typical grade range as found in the reading subtest. Youths who were in special classes performed similarly to those with less than 5th grade placement, and the dropouts again achieved scores at the 6th or 7th grade level. Mean raw scores of 12th graders and high school graduates were about the same. Youths who had begun college or were preparing to begin college scored higher than all others. As in the similar findings on the reading subtest, the higher raw score means for students with education above high school is probably a result of the group's composition (only the more superior students being included) rather than a reflection of educational level. It is also of interest that the modal age group in each grade showed about the best performance on the arithmetic test. Those youths who were younger than the modal age for their grade did not do noticeably better than the modal age group, as they did on the reading test. Those who were older than the typical age for each grade did achieve slightly lower scores. The fact that there were not in the arithmetic test, as in the reading test, striking differences between the mean scores of the groups of youths who had probably been accelerated or detained and the scores of the modal age-in-grade groups suggests that success in school is more dependent on developing reading ability than on acquiring arithmetic skills.

Overall there was no difference between the performance of boys and girls on the arithmetic subtest, the mean score being 23.0 for each. There were no significant differences between raw scores of boys and girls at single years of age or at half-years of age (figure 3 and tables 3 and 4). Likewise, there were no significant differences in arithmetic scores between boys and girls at any grade level, although from 9th grade on, the scores of boys were slightly higher than those of girls at each educational level (figure 4 and table 3).

Variability of arithmetic subtest raw scores was greater among boys in all 6-month age groups except three (the age groups 12 1/2, 15 1/2, and 17 1/2 years). The greater variability exhibited by the scores of boys was significant for ages 12-0 to 12-5, 13-0 to 13-11, and 17-0 to 17-5 (table 4).

Percentiles and Standard Scores

For the majority of testing purposes, the most satisfactory types of norms for achievement tests are those showing the examinee's position within his own grade level. In the present report, percentiles and *T* scores (normalized standard scores with a mean of 50 and standard deviation of 10) are employed for that purpose.[13] In addition, the same two measures are presented for the six age levels of the population surveyed.

Grade-equivalent scores, which are often used for achievement tests and are presented for the WRAT in Jastak's original work, are not shown in this report. Basically, grade equivalent tables have been omitted for two reasons: (1) the sample design and testing procedures used by HES are such that the construction of grade

equivalents would incorporate unacceptably large biases, and (2) shortcomings inherent in the grade equivalent concept itself make the measure less than desirable for grade norms, especially at levels beyond the elementary school grades. Elaboration on the two points follows.

The usual procedure for construction of grade equivalents is to select samples from specific grade populations and test them once or several times during the course of the school year.[13] The sample design for the HES called for selection of eligible youths from *households*. Examinations were administered throughout the year, and youths were tested whether they were enrolled in school, were on vacation, or had left school for any reason. In addition, testing was done in a mobile examination center, so seasonal variation in weather was a consideration in scheduling the 40 sample locations. Examination sites during the winter, approximately the middle of the school year, tended to be in warmer climates, while during warmer weather examinations took place in the more northern regions of the country. Grade equivalents like those constructed by Jastak would therefore be subject to a regional bias if developed from HES data. For example, if WRAT scores of youths in the South should be generally lower than those in the Northeast (an actual finding from the Health Examination Survey of children aged 6-11), then this difference would be reflected in the midgrade grade equivalents assigned to certain raw scores; that is, any regional differences would be reflected in the grade equivalents developed from raw scores obtained during the course of each school year.

Conceptually, grade equivalents assume that growth is uniform throughout the school year. The inclusion of grade equivalents in this report would require the assumption that learning is roughly uniform for every youth throughout his junior and senior high school years everywhere in the United States. That is a difficult assumption which would ignore both the planned and unplanned variation in the educational experiences of youths throughout the country.

There is also a problem in interpreting grade equivalents even though superficially they may appear quite simple. For example, an 8th grader's performance on the arithmetic test could result in a grade equivalent of 10.8. This does not necessarily mean that the person has mastered most arithmetic taught in the 10th grade, but more likely that he achieved a high score by superior performance on arithmetic taught up through the 8th grade.

Grade equivalents can be potentially misleading when used as a simple measure of achievement if they are construed as "norms" signifying satisfactory levels of achievement without consideration of such factors as intelligence or curriculum emphasis of the youths being evaluated. Grade equivalents generally tend to exaggerate the significance of small differences and to encourage the improper use of test scores. In addition, grade equivalents do not provide a good basis for comparing an examinee's performance on several tests, nor are they a better measure than other scales for assessing changes in an individual's achievement level. There is general agreement among educational psychologists that percentile rankings provide a sounder basis for interpreting a student's score on a particular test and for comparing his standing on a number of tests.[14]

Any reader wishing to examine grade equivalents from the present report may do so by simply using the mean raw scores for each grade as presented in tables 1 and 3 as grade equivalents for the midpoints of specific grades and then interpolating intermediate grade equivalents to represent fractions of grades. The school year covers roughly 10 months; thus successive school months can be expressed as decimal components of a given grade. For example, a grade equivalent of 12.0 indicates average achievement at the beginning of the 12th grade (September testing) and a grade equivalent of 12.5 indicates average achievement at the midpoint of the school year (February testing).

Percentiles have been derived from the raw scores on both the reading and arithmetic subtests. Percentile ranks reported in the tables represent the percentages of youths falling below designated raw scores. Tables 5 and 6 present reading test percentiles for the six age groups and for grades 7–12 (the appropriate grade levels for these ages). These percentiles are based on all persons of the given age or in the given grade.

Similar percentiles for the arithmetic subtest are presented for age and grade groups in tables 7 and 8, respectively.

Comparison of the two subtests with each other, with other measures of academic achievement, or with other psychological and physical measures may be misleading if based on percentile ranks. Percentiles reflect both the range of test scores obtained and the distribution of those scores within any category reported, in this case age and grade levels. Completely similar distributions of scores may not occur for each subsample. Indeed, the range of items attempted on a test like the WRAT would be expected to increase over the successive ages and grades in the population under discussion.

In view of the preceding discussion, the norm tables in this report present standard scores computed from the raw score distributions of each subtest. The standard score equivalents of raw scores are based on a common scale with a mean of 50 and a standard deviation of 10

Table A. Means and standard deviations (SD) on the reading and arithmetic subtests of the Wide Range Achievement Test for Jastak's standardization group and HES estimates for the United States among youths in 1966-70

Age in years and months	Jastak's standardization group[1]			HES sample, 1966-70[2]			
				Unsmoothed		Smoothed[3]	
	Number	Mean	SD	Mean	SD	Mean	SD
	Reading subtest						
12-0 to 12-5	314	43.92	11.78	41.67	11.37	42.04	11.49
12-6 to 12-11	336	45.64	11.81	42.41	11.61	42.87	11.87
13-0 to 13-5	321	46.40	11.75	44.52	12.62	44.38	12.24
13-6 to 13-11	325	48.73	11.92	46.21	12.49	46.19	12.70
14-0 to 14-5	340	51.14	11.87	47.85	12.98	47.53	12.71
14-6 to 14-11	351	52.29	12.06	48.52	12.67	48.52	12.96
15-0 to 15-5	324	54.31	12.13	49.18	13.22	49.39	13.10
15-6 to 15-11	265	54.93	12.20	50.48	13.40	50.84	13.27
16-0 to 16-11	558	55.76	12.72	52.85	13.19	52.33	13.71
17-0 to 17-11	485	57.29	12.76	53.67	14.55	53.26	13.87
	Arithmetic subtest						
12-0 to 12-5	301	23.71	5.46	18.82	4.76	19.19	5.03
12-6 to 12-11	323	25.22	5.70	19.57	5.30	19.73	5.37
13-0 to 13-5	305	26.31	6.08	20.79	6.04	20.58	5.79
13-6 to 13-11	309	27.63	6.10	21.39	6.04	21.59	6.14
14-0 to 14-5	328	28.30	6.15	22.60	6.33	22.47	6.35
14-6 to 14-11	345	29.48	6.38	23.43	6.68	23.20	6.52
15-0 to 15-5	314	29.50	6.37	23.56	6.55	23.79	6.68
15-6 to 15-11	248	29.65	6.63	24.39	6.80	24.51	6.83
16-0 to 16-11	544	29.85	6.91	25.58	7.15	25.24	7.20
17-0 to 17-11	480	30.60	7.25	25.74	7.65	25.66	7.40

[1]Jastak, J. F., and Jastak, S. R.: The Wide Range Achievement Test, Manual of Instructions, rev. ed. Wilmington, Del: Guidance Associates, 1965.

[2]Estimates of means and standard deviations for the United States based on the inflated HES sample. See appendix I for a further explanation and for the number of examinees on which findings are based.

[3]Means and standard deviations smoothed by a three-point moving average. End points estimated from two groups.

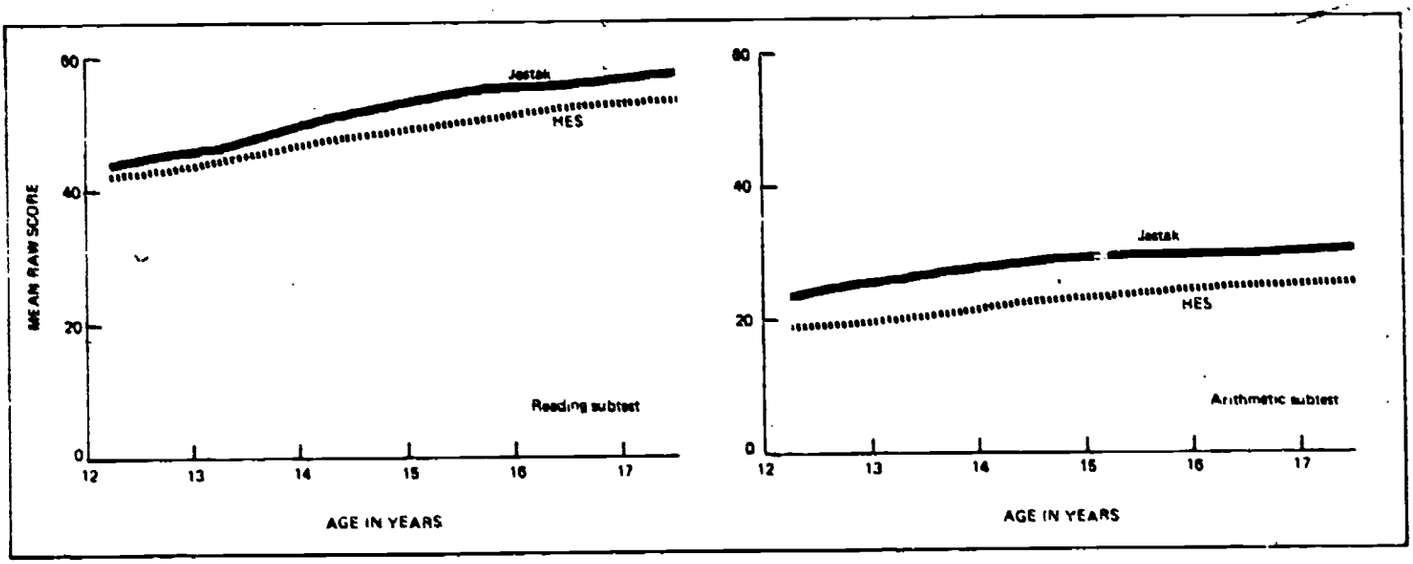

Figure 5. Mean raw scores on the reading and arithmetic subtests of the Wide Range Achievement Test for Jastak's standardization group (1965) and HES estimates for the United States among youths (1966-70), by age.

(*T* scores).[14] Although this method deviates from that used by Jastak and from the method followed in the earlier report on the children tested in HES, it provides standard scores which can be compared both within and across age and grade groups. Thus, the statement in the Cycle II report[1] counseling caution in the use of standard scores for across-age comparisons need not be included here. Subsequent reports on the adolescent survey will employ *T* scores in presenting results for other tests, such as the Wechsler Intelligence Scale for Children and the Goodenough-Harris Drawing Test.

Tables 9 and 10 present by single year of age the *T* score equivalents for reading and arithmetic raw scores, respectively. The *T* scores for each age level were computed from the test results for *all* persons of the age designated. In table 11, *T* score equivalents for reading raw scores are presented by each of the six grade levels appropriate to the age range of the population. Table 12 presents similar scores for the arithmetic subtest. Since it was decided that standards of performance at different educational levels should be based on the "typical" performance in each grade, the *T* scores in tables 11 and 12 were computed from the raw scores of *only* those youths who were at the modal age in each grade.

COMPARISON OF HES FINDINGS WITH OTHER DATA

As indicated previously, the Health Examination Survey sample was a highly representative probability sample of the noninstitutionalized population of the United States. It is of interest to compare the results of this survey with the data from the group on which Jastak standardized the 1965 revision of the WRAT. Limited information on the standardization sample appears in the WRAT Manual. The sample was drawn from schools in seven States. Apparently some effort was made to have various socioeconomic levels represented. IQ scores were used to develop a "mentally average" sample with representative dispersions of scores above and below the mean, but no attempt was made to obtain representative national sampling.[5] It should be noted that the present sample, on which the United States estimates are based, is nearly twice as large as Jastak's sample (appendix I).

As indicated in table A and figure 5, the average raw scores attained in the Health Examination Survey on the reading subtest and the arithmetic subtest were consistently lower than those reported for standardization groups. The differences were significant at every age level for both subtests. Raw scores on the reading subtest

of youths in the present study, except for those of 12-year-olds, tended to be more variable than were the scores of persons in the standardization sample. The HES arithmetic scores were also more variable except at ages 12 and 13.

The HES data can also be compared with those obtained by Schaie in the study summarized earlier.[7] In this case there is the opportunity to compare raw score means for each grade level obtained from a substantial sample of students (about 200 in each grade) with the HES national estimates of mean scores for each grade. As indicated in table B, the United States estimates are lower at every grade level for both the reading and the arithmetic subtests. Differences are significant in the 7th, 9th, and 10th grades for reading and in all but the 11th grade for arithmetic. The standard deviations are slightly larger for the national estimates in every case except reading in the 11th grade.

The most plausible explanation for the lower raw score means and greater variability of the scores obtained from the national sample of adolescents lies in the sampling and examination procedures used in HES. The previous studies, Jastak's standardization study and the study by Schaie, made use of some variety of stratification and quota sampling within school populations, thus limiting the range of potential sample persons far more than the sampling techniques employed by HES. A great effort went into having every person in the HES sample examined (leading to the 90-percent response), which certainly resulted in reaching some of the lower level and problem cases who were probably "lost" in the smaller scale efforts.

Table B. Means and standard deviations (SD) on the reading and arithmetic subtests of the Wide Range Achievement Test for the Schaie study sample and HES estimates for the United States for youths in 1966-70

Grade in school	Schaie sample[1]			HES sample, 1966-70[2]	
	Number	Mean	SD	Mean	SD
	Reading subtest				
Grade 7---	215	49.0	10.8	42.6	11.3
Grade 8---	210	47.2	11.4	46.3	11.6
Grade 9---	232	55.7	11.1	48.7	12.1
Grade 10--	199	55.8	11.1	52.0	11.7
Grade 11--	201	56.7	12.5	55.6	11.7
Grade 12--	172	60.1	10.8	58.7	11.3
	Arithmetic subtest				
Grade 7---	215	22.5	4.3	19.6	5.2
Grade 8---	210	24.3	5.0	21.6	5.8
Grade 9---	232	28.7	5.5	23.4	6.2
Grade 10--	199	29.1	5.9	25.0	6.3
Grade 11--	201	27.6	6.3	26.8	6.5
Grade 12--	172	31.4	6.2	28.1	6.8

[1] Vital and Health Statistics, Series 2, No. 24.

[2] Estimates of means and standard deviations for the United States based on the inflated HES sample. See appendix I for a further explanation and for the number of examinees on which the findings are based.

SUMMARY

This report presents national estimates of school achievement as measured by the reading and arithmetic subtests of the Wide Range Achievement Test for the noninstitutionalized population of the United States 12-17 years of age. Data were obtained in the Health Examination Survey of 1966-70. In the survey a probability sample of 7,514 youths was selected to represent the 23 million adolescents 12-17 years residing in this country. A total of 6,768, or 90 percent, of the sample youths were examined. Because of the sample design, adjustment for nonresponse, and weighting procedures used in the survey, findings for these youths may be considered to be representative of the total noninstitutionalized U.S. population of 12- through 17-year-olds with respect to age, sex, race, region, and other socioeconomic characteristics.

Test results have been presented by age, sex, and educational level in their raw score form to permit comparison with other studies using the WRAT. Percentile ranks and normalized standard score (*T* score) equivalents of the raw scores have also been included.

Findings on the two WRAT subtests have been compared with the data from Jastak's standardization sample and with the findings from a recent study on the test done by Schaie. The

HES estimates of raw score means for age and grade levels are consistently lower than those obtained in the two previous studies.

The Cycle III HES data demonstrate a continued development of reading and arithmetic skills through the adolescent years and as formal education increases. A noteworthy finding is that girls in the age range surveyed performed better than boys on the word recognition and pronunciation task presented by the WRAT. It might be pointed out that a similar finding came from the HES Cycle II program when the Level I reading subtest of the WRAT was administered to children 6-11 years old.[1] No significant differences between boys and girls in arithmetic computational skills were found in either survey.

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Table 1. Mean reading raw scores on the Wide Range Achievement Test for youths, by sex, age, and educational level: United States, 1966-70

Sex and age	All levels	Grade in school									High school graduate	More than high school education	Left high school before graduating	Special placement
		4 and below	5	6	7	8	9	10	11	12				
Both sexes	Mean raw score													
12-17 years	48.5	22.0	27.9	36.2	42.6	46.3	48.7	52.0	55.6	58.7	58.2	66.2	39.4	23.1
12 years	42.1	21.4	29.2	38.0	44.2	48.8	*	-	-	-	-	-	-	22.1
13 years	45.3	*	25.5	30.1	42.0	48.3	51.8	*	*	-	-	-	-	20.2
14 years	48.2	*	*	30.3	36.5	43.8	51.8	55.0	*	*	-	*	*	23.0
15 years	49.8	-	*	*	28.2	35.2	44.9	53.6	58.6	*	*	*	*	*
16 years	52.8	*	*	-	*	37.6	39.9	50.0	56.7	59.0	*	*	41.2	*
17 years	53.7	-	-	-	*	*	30.3	42.8	51.6	58.7	58.2	66.0	39.2	*
Boys														
12-17 years	47.2	22.5	26.9	35.3	41.8	45.6	47.7	51.0	54.8	58.1	59.1	64.4	39.5	22.7
12 years	41.1	20.4	27.4	37.1	43.6	49.2	*	-	-	-	-	-	-	22.1
13 years	44.6	*	25.4	29.8	41.7	46.3	50.4	*	-	-	-	-	-	19.5
14 years	47.0	*	*	28.1	36.8	42.9	51.8	55.1	-	-	-	-	*	23.1
15 years	48.9	-	-	*	27.4	34.5	44.6	53.6	59.1	*	*	-	*	*
16 years	51.3	-	-	-	*	38.3	39.1	47.8	55.9	58.9	-	*	36.2	*
17 years	51.6	-	-	-	*	*	28.6	41.0	50.6	58.0	59.0	64.3	39.5	*
Girls														
12-17 years	49.7	21.5	29.3	37.4	43.5	46.9	49.8	53.1	56.4	59.3	57.8	67.7	40.7	23.8
12 years	43.1	21.9	31.9	39.1	44.8	48.5	-	-	-	-	-	-	-	22.1
13 years	46.0	*	25.6	30.6	42.3	48.2	53.1	*	*	-	-	-	-	21.6
14 years	49.4	*	-	35.6	36.1	45.1	51.8	54.9	*	-	-	-	*	*
15 years	50.8	-	*	*	31.0	36.3	45.3	53.5	58.2	*	*	-	*	*
16 years	54.4	*	*	-	*	34.5	40.2	52.2	57.5	59.2	*	-	45.6	*
17 years	55.8	-	-	-	*	-	37.9	46.8	52.7	59.4	57.9	67.4	39.8	*

NOTE: Mean raw scores for the modal age-in-grade groups are underlined.

Table 2. Means, standard deviations (SD), coefficients of variation (SD/mean), and standard errors (SE) of means for raw scores on the reading subtest of the Wide Range Achievement Test for youths, by age and sex: United States, 1966-70

Age in years and months	Both sexes				Boys				Girls			
	Mean	SD	SD/mean	SE of mean	Mean	SD	SD/mean	SE of mean	Mean	SD	SD/mean	SE of mean
12-0 to 17-11	48.47	13.61	.281	0.42	47.25	13.92	.295	0.50	49.72	13.18	.265	0.40
12-0 to 12-5	41.67	11.37	.273	0.46	40.52	11.59	.286	0.63	42.80	11.04	.258	0.83
12-6 to 12-11	42.41	11.61	.274	0.58	41.58	12.08	.290	0.84	43.31	11.02	.254	0.55
13-0 to 13-5	44.52	12.62	.284	0.49	44.07	13.29	.302	0.59	45.01	11.86	.264	0.68
13-6 to 13-11	46.21	12.49	.270	0.64	45.25	13.10	.290	1.05	47.19	11.76	.249	0.68
14-0 to 14-5	47.85	12.98	.271	0.69	46.62	13.72	.294	1.06	49.07	12.08	.246	0.85
14-6 to 14-11	48.52	12.67	.261	0.66	47.38	13.29	.280	0.83	49.71	11.86	.239	0.64
15-0 to 15-5	49.18	13.22	.269	0.65	48.03	13.76	.286	0.92	50.44	12.47	.247	0.82
15-6 to 15-11	50.48	13.40	.266	1.04	49.86	13.92	.279	1.12	51.07	12.87	.252	1.11
16-0 to 16-5	52.78	12.73	.241	0.64	51.52	13.18	.256	0.92	54.15	12.08	.223	0.84
16-6 to 16-11	52.92	13.66	.258	0.75	51.03	13.77	.270	0.94	54.73	13.31	.243	0.98
17-0 to 17-5	53.05	14.42	.272	0.90	51.23	15.68	.306	1.40	54.86	12.78	.233	0.91
17-6 to 17-11	54.30	14.67	.270	0.91	51.95	13.40	.258	1.12	56.69	15.49	.273	1.33

Table 3. Mean arithmetic raw scores on the Wide Range Achievement Test for youths, by sex, age, and educational level: United States, 1966-70

Sex and age	All levels	Grade in school									High school graduate	More than high school education	Left high school before graduating	Special placement
		4 and below	5	6	7	8	9	10	11	12				
	Mean raw score													
Both sexes														
12-17 years	23.0	10.3	13.8	17.4	19.6	21.6	23.4	25.0	26.8	28.1	27.3	32.0	17.9	11.4
12 years	19.2	11.3	14.5	17.9	19.3	22.0	*	-	-	-	-	-	-	10.8
13 years	21.1	*	12.7	15.6	19.7	22.2	23.8	*	*	-	-	-	-	10.5
14 years	23.0	*	*	16.4	18.2	21.2	24.6	25.8	*	*	-	-	*	11.4
15 years	24.0	*	*	*	15.9	17.8	22.2	25.5	27.4	*	*	-	*	*
16 years	25.6	*	*	*	*	18.4	19.3	24.3	27.3	28.9	*	*	18.7	*
17 years	25.7	-	-	-	*	*	18.0	21.0	25.2	27.9	27.4	31.8	17.8	*
Boys														
12-17 years	23.0	9.7	13.2	17.6	19.5	21.6	23.6	25.2	27.3	28.6	28.1	33.8	17.9	11.4
12 years	19.1	11.6	13.9	18.0	20.0	22.0	*	-	-	-	-	-	-	10.6
13 years	21.1	*	11.7	16.1	19.7	22.5	24.5	*	-	-	-	-	-	11.0
14 years	23.0	*	*	16.2	18.3	21.2	25.1	26.8	-	*	-	-	*	*
15 years	24.1	*	-	*	15.8	17.6	22.6	26.2	27.3	*	*	-	*	*
16 years	25.8	-	-	-	*	*	19.6	24.2	28.0	30.3	-	*	16.8	*
17 years	25.6	-	-	-	*	*	*	20.6	25.8	28.2	28.1	33.6	18.6	*
Girls														
12-17 years	23.0	11.0	14.5	17.2	19.6	21.6	23.2	24.6	26.3	27.7	26.9	30.5	18.0	11.4
12 years	19.3	11.7	15.4	17.7	19.8	22.0	-	-	-	-	-	-	-	11.2
13 years	21.1	*	14.7	15.0	19.8	21.9	28.3	*	*	-	-	-	-	9.4
14 years	23.0	*	-	*	17.9	21.3	24.1	25.0	*	-	-	-	*	*
15 years	23.9	-	*	*	16.4	18.2	21.7	24.9	27.4	*	*	-	*	*
16 years	25.3	*	*	-	*	*	18.7	24.4	26.7	27.8	*	*	20.4	*
17 years	25.8	-	-	-	*	-	*	21.7	24.6	27.7	27.1	30.3	16.9	*

NOTE: Mean raw scores for the modal age-in-grade groups are underlined.

Table 4. Means, standard deviations (SD), coefficients of variation (SD/mean), and standard errors (SE) of means for raw scores on the arithmetic subtest of the Wide Range Achievement Test for youths, by age and sex: United States, 1966-70

Age in years and months	Both sexes				Boys				Girls			
	Mean	SD	SD/mean	SE of mean	Mean	SD	SD/mean	SE of mean	Mean	SD	SD/mean	SE of mean
12-0 to 17-11	23.00	6.95	.302	0.26	23.02	7.13	.310	0.27	22.98	6.76	.294	0.27
12-0 to 12-5	18.82	4.76	.253	0.27	18.78	5.09	.271	0.33	18.86	4.40	.233	0.33
12-6 to 12-11	19.57	5.30	.271	0.33	19.43	5.14	.264	0.38	19.72	5.45	.276	0.38
13-0 to 13-5	20.79	6.04	.290	0.31	20.89	6.44	.308	0.42	20.70	5.57	.269	0.42
13-6 to 13-11	21.39	6.04	.282	0.34	21.33	6.40	.300	0.53	21.47	5.65	.263	0.53
14-0 to 14-5	22.60	6.33	.280	0.38	22.30	6.38	.286	0.48	22.89	6.26	.274	0.48
14-6 to 14-11	23.43	6.68	.285	0.40	23.66	6.99	.295	0.52	23.21	6.32	.272	0.52
15-0 to 15-5	23.56	6.55	.278	0.29	23.66	6.69	.283	0.42	23.46	6.38	.272	0.42
15-6 to 15-11	24.39	6.80	.279	0.51	24.51	6.61	.270	0.54	24.29	6.98	.287	0.54
16-0 to 16-5	25.31	6.91	.273	0.49	25.47	7.18	.282	0.54	25.13	6.59	.262	0.54
16-6 to 16-11	25.85	7.40	.286	0.41	26.28	7.62	.290	0.45	25.43	7.15	.281	0.45
17-0 to 17-5	25.87	7.77	.300	0.50	25.84	8.21	.318	0.61	25.90	7.31	.282	0.61
17-6 to 17-11	25.61	7.53	.294	0.43	25.44	7.36	.289	0.51	25.79	7.70	.299	0.51

Table 5. Percentile equivalents of raw scores on the reading subtest of the Wide Range Achievement Test for youths, by sex and age: United States, 1966-70

Sex and percentile	Total	Age in years					
		12	13	14	15	16	17
Both sexes	Raw score[1]						
99	77	67	69	74	75	80	82
98	74	65	67	72	73	77	7[illegible]
97	72	63	66	71	72	76	78
96	71	62	65	69	70	73	77
95	70	61	64	68	69	73	75
90	66	57	61	64	67	69	72
85	62	55	58	61	64	66	69
80	60	52	57	59	62	64	66
75	58	50	55	58	60	62	64
70	56	49	53	56	58	60	62
65	55	47	52	54	57	59	60
60	53	46	50	53	55	57	58
55	51	44	48	51	53	56	57
50	50	42	46	50	51	54	55
45	48	40	45	48	50	52	53
40	46	39	43	46	48	50	51
35	44	37	41	44	45	49	50
30	41	35	38	42	43	47	47
25	39	33	36	39	40	45	45
20	36	31	33	36	38	42	42
15	33	29	30	33	35	39	39
10	29	27	28	30	30	34	34
5	25	24	24	26	26	28	28
4	24	23	22	25	26	27	27
3	23	22	22	24	24	25	25
2	22	20	21	22	22	23	23
1	19	17	19	20	20	22	22
Boys							
99	76	66	69	74	75	79	79
98	73	65	67	72	7[illegible]	77	77
97	72	64	65	71	7[illegible]	74	7[illegible]
96	70	63	65	[illegible]	70	7[illegible]	75
95	69	51	64	67	6[illegible]	[illegible]	74
90	65	57	61	63	67	68	70
85	62	54	59	61	64	65	66
80	60	52	57	59	62	63	64
75	57	50	55	57	60	62	62
70	55	48	53	55	58	59	60
65	54	46	52	53	56	57	58
60	52	44	50	52	54	55	56
55	50	42	48	50	52	53	55
50	48	41	46	49	50	52	53
45	46	39	44	46	48	50	52
40	44	37	42	45	46	48	50
35	42	36	40	43	44	47	48
30	40	34	37	39	41	45	45
25	37	32	35	37	39	44	44
20	34	30	32	33	36	40	40
15	31	28	29	31	32	35	36
10	28	25	26	28	29	32	32
5	24	22	22	24	25	27	27
4	23	21	21	24	24	26	26
3	22	20	20	22	23	24	24
2	20	19	19	21	21	22	22
1	18	18	18	18	19	20	20
Girls							
99	78	67	68	73	76	80	82
98	75	66	68	72	73	78	81
97	73	62	67	70	72	76	80
96	72	62	65	69	70	75	79
95	71	61	64	68	69	73	77
90	67	57	60	64	67	71	73
85	63	55	58	61	64	68	70
80	61	52	57	60	62	65	69
75	59	51	55	58	60	63	67
70	57	50	54	57	58	61	65
65	56	48	52	55	57	60	62
60	54	47	51	54	55	59	60
55	52	46	49	52	54	57	58
50	51	44	47	50	52	56	57
45	49	41	45	49	51	54	55
40	47	40	44	47	49	52	53
35	45	38	42	45	47	51	51
30	43	37	40	43	45	49	49
[illegible]	40	35	37	41	42	47	48
[illegible]	38	32	34	38	40	44	45
15	35	31	31	35	37	40	40
10	31	28	29	32	32	36	36
5	27	25	26	28	29	31	32
4	26	25	26	27	27	28	30
3	25	23	24	26	26	27	27
2	23	22	22	24	24	25	25
1	21	20	20	21	22	23	23

Sex and percentile	Total	Age in years					
		12	13	14	15	16	17
Boys—Con.	Raw score[1]						
45	46	39	44	46	48	50	52
40	44	37	42	45	46	48	50
35	42	36	40	43	44	47	48
30	40	34	37	39	41	45	45
25	37	32	35	37	39	44	44
20	34	30	32	33	36	40	40
15	31	28	29	31	32	35	36
10	28	25	26	28	29	32	32
5	24	22	22	24	25	27	27
4	23	21	21	24	24	26	26
3	22	20	20	22	23	24	24
2	20	19	19	21	21	22	22
1	18	18	18	18	19	20	20

[1]Score below which the given percentage of the population falls.

Table 6. Percentile equivalents of raw scores on the reading subtest of the Wide Range Achievement Test for youths 12-17 years, by sex and grade in school: United States, 1966-70

Sex and percentile	Grade in school					
	7	8	9	10	11	12
Both sexes	Raw score[1]					
99	66	70	73	75	79	82
98	64	68	71	73	78	81
97	63	66	69	72	76	79
96	62	65	68	71	75	77
95	61	64	67	70	74	77
90	57	61	63	67	70	73
85	55	59	61	65	68	71
80	53	57	59	62	65	69
75	51	55	57	61	64	67
70	50	53	56	59	62	65
65	48	52	54	58	61	64
60	46	50	53	56	59	62
55	45	49	51	54	58	60
50	42	47	50	53	56	58
45	41	46	48	51	55	57
40	39	44	47	50	53	56
35	37	42	45	48	52	55
30	36	40	43	46	50	53
25	34	38	40	44	49	52
20	32	35	38	42	46	49
15	30	32	35	39	44	47
10	28	30	31	36	40	45
5	24	27	27	31	35	40
4	24	26	26	29	32	39
3	23	25	25	27	31	36
2	21	23	24	26	27	33
1	19	21	22	23	25	30
Boys						
99	65	70	74	75	79	81
98	63	67	72	73	77	79
97	63	66	69	72	76	77
96	62	65	68	71	75	75
95	61	64	67	70	74	75
90	57	61	63	67	69	72
85	55	59	61	65	67	70
80	52	57	59	62	64	68
75	51	55	57	61	63	66
70	49	53	55	59	62	64
65	47	52	53	57	60	63
60	45	50	52	55	58	61
55	44	48	50	54	56	59
50	42	46	49	52	55	58
45	41	45	47	49	54	57
40	38	43	45	48	52	55
35	36	41	44	46	51	55
30	35	38	41	45	49	54
25	33	36	39	43	47	52
20	30	34	36	40	45	50
15	28	31	34	37	43	47
10	26	29	30	34	40	45
5	23	26	27	28	34	40
4	23	25	25	26	31	39
3	22	24	24	25	30	36
2	21	22	23	23	26	33
1	18	20	22	22	24	30
Girls						
99	67	69	72	76	80	82
98	64	68	71	74	78	82
97	63	66	70	72	76	80
96	62	65	68	71	74	79
95	61	64	67	70	73	78
90	58	60	64	67	71	75
85	56	58	62	64	68	72
80	54	57	60	62	66	70
75	51	55	58	60	64	68
70	50	53	57	59	62	66
65	48	52	56	58	61	65
60	47	51	54	56	60	64
55	45	49	53	55	59	60
50	44	48	51	54	57	59
45	42	46	50	52	56	58
40	40	45	48	51	54	56
35	39	43	46	50	52	55
30	37	41	44	48	51	53
25	35	39	42	46	50	52
20	33	37	39	44	48	49
15	31	34	36	40	45	48
10	29	31	33	38	41	45
5	27	28	29	35	35	40
4	27	27	28	34	34	37
3	25	26	27	31	32	35
2	23	25	26	29	29	34
1	20	23	24	27	27	32

[1]Score below which the given percentage of the population falls.

Table 7. Percentile equivalents of raw scores on the arithmetic subtest of the Wide Range Achievement Test for youths, by sex and age: United States, 1966-70

Sex and percentile	Total	Age in years					
		12	13	14	15	16	17
Both sexes	Raw score[1]						
99	40	33	36	38	40	41	44
98	38	31	33	37	37	39	43
97	37	29	32	36	36	38	41
96	36	28	32	35	35	38	40
95	35	27	31	34	34	37	39
90	32	26	30	32	32	35	36
85	31	24	28	30	31	33	33
80	29	23	26	29	30	32	32
75	28	22	25	28	29	31	31
70	26	21	24	26	28	29	30
65	25	21	23	25	27	28	29
60	24	20	22	24	26	27	27
55	23	19	22	24	25	27	27
50	23	19	21	23	24	26	26
45	22	18	20	22	23	25	25
40	21	18	19	21	22	24	24
35	20	17	18	20	21	23	23
30	19	16	17	19	20	22	22
25	18	16	17	18	19	20	21
20	17	15	16	18	18	19	19
15	16	14	15	16	17	18	18
10	14	13	14	15	15	16	16
5	12	12	12	13	13	14	14
4	12	12	12	12	12	13	13
3	12	11	11	11	11	12	12
2	11	10	10	10	10	11	11
1	10	9	9	9	9	10	10
Boys							
99	40	34	37	37	38	41	44
98	38	31	34	36	37	40	43
97	37	29	33	35	36	39	41
96	36	29	32	34	35	38	40
95	35	28	32	34	35	38	39
90	32	26	30	32	32	36	36
85	31	24	28	30	31	34	34
80	29	23	26	29	30	32	32
75	28	22	25	28	29	31	31
70	27	21	25	27	28	30	30
65	26	21	23	25	27	29	29
60	25	20	23	24	26	28	28
55	24	19	22	24	25	27	27
50	23	19	21	23	24	26	26
45	22	18	20	22	24	25	25
40	21	18	20	21	23	24	24
35	20	17	19	20	21	23	23
30	19	16	17	19	21	22	22
25	18	15	16	18	20	21	21
20	17	15	15	17	18	19	19
15	15	14	14	16	16	17	18
10	14	13	13	14	15	16	16
5	12	12	12	12	12	13	14
4	12	11	11	12	12	13	13
3	11	11	11	11	12	12	12
2	11	9	9	10	10	11	11
1	9	8	8	8	9	10	10
Girls							
99	40	32	34	38	41	41	44
98	38	31	32	37	38	39	43
97	37	29	32	36	37	38	40
96	36	28	31	35	36	37	39
95	35	27	31	35	35	36	38
90	32	26	29	32	33	34	36
85	31	24	27	30	31	33	34
80	29	23	26	29	30	31	32
75	27	22	25	27	28	30	31
70	26	21	24	26	27	29	30
65	25	21	23	25	26	28	28
60	24	20	22	24	25	27	27
55	23	20	22	23	24	26	26
50	22	19	21	22	23	25	25
45	22	18	20	22	23	24	24
40	21	18	19	21	22	23	24
35	20	17	18	20	21	22	23
30	19	17	18	19	20	21	22
25	18	16	17	18	19	20	21
20	17	15	16	18	18	19	20
15	16	14	15	17	17	18	18
10	15	13	14	15	15	16	17
5	13	12	13	13	13	14	15
4	12	12	12	13	13	13	14
3	12	11	11	12	12	13	13
2	11	10	10	11	11	12	12
1	10	9	9	10	10	11	11

[1]Score below which the given percentage of the population falls.

Table 8. Percentile equivalents of raw scores on the arithmetic subtest of the Wide Range Achievement Test for youths 12-17 years, by sex and grade in school: United States, 1966-70

Sex and percentile	Grade in school					
	7	8	9	10	11	12
Both sexes	Raw score					
99	33	36	38	39	41	45
98	32	34	36	38	41	43
97	31	33	35	37	40	41
96	30	32	35	36	39	40
95	29	32	34	35	38	40
90	26	30	31	33	35	37
85	25	28	30	32	34	36
80	24	26	29	31	32	34
75	23	25	28	29	31	32
70	22	24	27	28	30	31
65	21	24	25	27	29	31
60	21	23	25	26	28	29
55	20	22	24	25	27	29
50	19	21	23	25	27	28
45	19	21	22	24	26	27
40	18	20	22	23	25	26
35	17	19	21	22	24	25
30	17	18	20	21	23	24
25	16	17	19	21	22	24
20	15	17	18	20	21	22
15	14	16	17	19	20	21
10	13	14	15	17	18	20
5	12	13	13	15	16	17
4	12	13	13	14	16	17
3	11	12	12	13	15	16
2	11	12	12	13	14	15
1	10	10	12	12	13	13
Boys						
99	34	36	38	38	41	46
98	32	34	36	38	40	44
97	31	33	35	37	40	41
96	30	32	34	37	39	41
95	29	32	34	35	38	40
90	26	30	32	33	36	38
85	25	28	30	32	34	36
80	24	26	29	31	32	35
75	23	26	28	30	31	33
70	22	25	27	29	31	32
65	21	24	26	28	30	31
60	21	23	25	27	29	30
55	20	22	24	26	28	29
50	19	21	23	25	27	28

Sex and percentile	Grade in school					
	7	8	9	10	11	12
Boys—Con.	Raw score					
45	19	20	23	24	27	27
40	18	19	22	24	26	27
35	17	19	21	23	25	26
30	16	18	20	22	24	25
25	15	17	19	21	23	24
20	15	16	18	19	22	23
15	14	15	17	18	21	22
10	13	14	15	17	19	20
5	12	13	14	15	16	18
4	12	13	13	14	15	17
3	11	12	13	13	14	16
2	11	12	12	13	13	15
1	10	10	12	12	13	13
Girls						
99	33	34	38	39	41	45
98	32	33	36	38	41	43
97	31	32	36	36	40	41
96	29	32	35	36	38	40
95	28	31	34	35	37	39
90	26	29	31	33	35	37
85	24	28	30	31	34	35
80	23	26	29	30	32	33
75	23	25	27	29	31	32
70	22	24	26	28	30	31
65	21	23	25	27	28	30
60	20	22	24	26	28	29
55	20	22	23	25	27	28
50	19	21	23	24	26	27
45	19	21	22	23	25	26
40	18	20	21	23	24	26
35	18	19	20	22	23	24
30	17	18	19	21	22	24
25	16	18	19	20	21	23
20	16	17	18	20	20	22
15	15	16	17	19	19	21
10	13	15	15	17	18	20
5	12	13	14	15	17	17
4	12	13	13	15	16	17
3	12	12	12	14	15	16
2	11	12	12	13	14	15
1	9	11	11	12	13	14

Score below which the given percentage of the population falls.

Table 9. *T* score equivalents of raw scores on the reading subtest of the Wide Range Achievement Test for youths, by age: United States, 1966-70

T score	Age in years						*T* score	Age in years					
	12	13	14	15	16	17		12	13	14	15	16	17
	Raw score							Raw score					
75	69-89	71-89	76-89	78-89	82-89	84-89	50	42	46-47	49-50	51	53-54	55
74	68	70	75	77	81	83	49	41	45	48	50	52	53-54
73	67	69	74	76	80	82	48	40	44	46-47	48-49	51	52
72	66	68	73	75	79	81	47	38-39	42-43	45	46-47	49-50	51
71	65		72	74	78	80	46	37	40-41	44	45	48	49-50
70	64	67	71	73	77	79	45	36	38-39	42-43	43-44	46-47	48
69	63	66	70	72	76	78	44	34-35	36-37	40-41	41-42	45	46-47
68	62	65	69	71	74-75	77	43	33	35	38-39	40	44	45
67	61		68	70	73	76	42	32	34	36-37	38	43	44
66	60	64	67	69		75	41	30-31	32-33	35	38	41-42	42-43
65	59	63	66	68	72	74	40	29	31	34	37	40	41
64	58	62	65		71	73	39	28	30	33	36	39	40
63	57	61	64	67	70	72	38	27	29	32	35	38	39
62	56	60	63	66	68-69	71	37	26	28	31	34	36-37	38
61	55	59	62	64-65	67	70	36	25	27	30	33	35	37
60	54	58	61	63	66	68-69	35	23-24	26	29	31-32	34	36
59	53	57	60	62	65	67	34	22	25	28	30	33	35
58	52	56	59	61	63-64	66	33	21	24	27	29	32	34
57	51	55	58	60	62	65	32	20	23	26	27-28	30-31	33
56	49-50	54	57	59	61	63-64	31	19	22	24-25	26	29	31-32
55	48	53	55-56	58	60	61-62	30	17-18	20-21	23	25	28	30
54	47	52	54	57	59	60	29	16	19	22	24	26-27	29
53	46	51	53	55-56	57-58	59	28	15	18	20-21	22-23	25	27-28
52	47	49-50	52	54	56	57-58	27	14	17	19	21	24	26
51	43-44	48	51	52-53	55	56	26	13	16	18	20	23	25
							25	00-12	00-15	00-17	00-19	00-22	00-24

Table 10. *T* score equivalents of raw scores on the arithmetic subtest of the Wide Range Achievement Test for youths, by age: United States, 1966-70

T score	Age in years					
	12	13	14	15	16	17
	Raw score					
75	34-56	37-56	40-56	41-56	42-56	46-56
74	33	36	39	40	41	45
73		35	38	39		44
72	32	34		38	40	
71			37			43
70	31	33		37	39	42
69	30		36	36		41
68	29	32	35		38	40
67	28			35		39
66		31	34		37	
65	27		33	34		38
64					36	37
63	26	30	32	33	35	36
62	25	29	31	32		35
61		28			34	34
60	24	27	30	31	33	33
59			29		32	
58	23	26		30		32
57			28	29	31	31
56	22	25	27	28	30	
55		24	26		29	30
54	21			27		29
53		23	25	26	28	28
52	20	22	24	25	27	27
51			23			

T score	Age in years					
	12	13	14	15	16	17
	Raw score					
50	19	21		24	26	26
49		20	22	23	25	25
48	18				24	24
47		19	21	22	23	23
46	17	18	20	21		
45					22	22
44	16	17	19	20	21	21
43			18	19	20	
42		16				20
41	15		17	18	19	19
40	14	15		17	18	18
39			16	16	17	
38	13	14	15			17
37				15	16	16
36	12	13	14	14	15	15
35		12	13		14	14
34	11			13		
33	10	11	12	12	13	13
32			11		12	12
31	09	10	10	11	11	11
30	08	09				
29			09	10	10	10
28	07	08	08	09	09	09
27		07	07	08	08	08
26	06	06	06	06-07	07	07
25	00-05	00-05	00-05	00-05	00-06	00-06

Table 11. *T* score equivalents of raw scores on the reading subtest of the Wide Range Achievement Test for youths 12-17 years, by grade in school: United States, 1966-70

T score	Grade in school					
	7	8	9	10	11	12
	Raw score					
75	68-89	70-89	76-89	77-89	82-89	84-89
74	67	69	75	76	81	83
73	66		74	75	80	82
72		68				
71	65		73	74	79	
70	64	67	72	73	78	81
69	63	66	71	72	77	80
68	62		70	71	76	79
67		65	69	70	75	78
66	61		68		74	77
65	60	64	67	69	73	75-76
64	59	63	66	68	72	74
63	58	62	65		71	73
62	57	61	64	67	69-70	72
61	56	60	63	66	68	71
60	55	59	62	65	67	70
59	54	58		64	66	69
58	53	57	61	63	65	68
57	52	56	60	62	64	67
56	51	55	59	61	63	66
55	50	54	58	60	62	65
54	49	53	56-57	59	61	64
53	48	52	55	58	60	62-63
52	47	51	54	57	59	61
51	46	50	53	55-56	58	60
50	45	49	52	54	57	59
49	43-44	48	51	53	56	58
48	42	46-47	50	52	55	57
47	41	45	49	51	54	56
46	40	44	48	50	53	55
45	39	43	47	48-49	52	54
44	38	42	46	47	51	53
43	37	41	45	46	50	51-52
42	36	39-40	44	44-45	49	50
41	35	38	42-43	43	47-48	49
40	33-34	36-37	41	41-42	46	48
39	32	35	39-40	40	45	46-47
38	31	34	38	39	44	45
37	30	33	36-37	38	42-43	44
36	29	32	35	37	41	42-43
35	28	31	34	36	39-40	41
34		30	33	35	37-38	40
33	27	29	32	34	36	38-39
32	26		31	32-33	35	36-37
31		28	30	31	33-34	35
30	25	27	29	30	32	34
29	24		27-28	29	30-31	33
28	23	26		28	28-29	32
27			26	27	27	31
26	22	25	25	26	26	30
25	00-21	00-24	00-24	00-25	00-25	00-29

[1] *T* scores for each grade level are computed from the test results of *only* those youths who were the modal age in each grade, for example, only the 12-year-olds in the 7th grade and the 13-year-olds in the 8th.

Table 12. *T* score equivalents of raw scores on the arithmetic subtest of the Wide Range Achievement Test for youths 12-17 years, by grade in school: United States, 1966-70

T score	Grade in school[1]					
	7	8	9	10	11	12
	Raw score					
75	34-56	37-56	39-56	40-56	42-56	46-56
74	33			39		
73		36	38		41	45
72	32	35		38		
71		34	37			44
70	31	33		37	40	43
69	30		36			42
68	29	32		36	39	41
67			35		38	40
66	28			35		
65	27	31	34		37	39
64			33	34		
63	26	30		33	36	38
62			32			37
61	25	29		32	35	36
60		28	31		34	35
59	24	27	30			34
58				31	33	33
57	23	26	29	30	32	
56			28	29	31	32
55	22	25				
54		24	27	28	30	31
53	21		26	27	29	30
52		23				29
51	20		25	26	28	28
50		22	24		27	27
49	19			25		
48		21	23	24	26	26
47					25	25
46	18	20	22	23		
45		19			24	24
44	17		21	22	23	
43		18	20	21		23
42	16				22	22
41		17	19			
40				20	21	21
39	15		18		20	
38		16		19		20
37	14			18	19	
36		15	17	17		19
35					18	18
34	13		16	16		
33		14	15		17	17
32				15		
31		13	14		16	16
30	12			14	15	15
29			13			
28		12		13	14	14
27					13	13
26	11		12	12		
25	00-10	00-11	00-11	00-11	00-12	00-12

[1] *T* scores for each grade level are computed from the test results of *only* those youths who were the modal age in each grade, for example, only the 12-year-olds in the 7th grade and the 13-year-olds in the 8th.

APPENDIX I

DEFINITIONS

Age.—The age recorded for each youth was age at last birthday as of the date of examination. Age was confirmed by comparison with the date of birth on the youth's birth certificate. The age criterion for inclusion in the sample was the age at the time of the first interview. Since the examination usually took place 2 to 4 weeks after the interview, some youths who were 17 years old at the time of interview became 18 years old by the time of examination. There were 58 such cases. In the adjustment and weighting procedures and in the analysis, these youths were included in the 17-year-old group.

Grade.—The grade placement of sample youths was obtained from the questionnaire sent to the schools they attended. If educational level was not available from the school questionnaire, grade placement or the fact of having completed or left school was determined from information noted by examiners on one of the psychological test record forms. For youths on summer vacation, the grade placement recorded was the grade the youth would enter in the fall. Those included in the "more than high school education" category are youths who were enrolled in colleges or training programs beyond high school level or youths on summer vacation after high school graduation who planned to continue their education in the fall.

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APPENDIX II

TECHNICAL NOTES

The Survey Design

The sample designs for the first three programs, Cycles I-III, of the Health Examination Survey were essentially similar in that each was a multistage, stratified probability sample of clusters of households in land-based segments. The successive elements for this sample design are primary sampling unit (PSU), census enumeration district (ED), segment (a cluster of households), household, eligible youth, and finally, the sample youth.

The 40 sample areas and the segments utilized in the design of Cycle III were the same as those used in Cycle II. Previous reports describe in detail the sample design used for Cycle II and in addition discuss the problems and considerations given to other types of sampling frames and whether or not to control the selection of siblings.[2,15]

Requirements and limitations placed on the design for Cycle III were similar to those for the design for Cycle II.

1. The target population was defined as the civilian, noninstitutionalized population of the United States (including Alaska and Hawaii) in the age range of 12-17 years with the special exclusion of children residing on reservation lands of the American Indians, an exclusion adopted as a result of operational problems encountered on these lands in Cycle I.

2. The time period of data collection was limited to about 3 years, and the length of the individual examination within the specially constructed mobile examination center was between 2 and 3 hours.

3. Ancillary data was collected on specially designed household, medical history, and school questionnaires and from copies of birth certificates.

4. Examination objectives were related primarily to factors of physical and intellectual growth and development.

5. The sample was sufficiently large to yield reliable findings within broad geographic regions and population density groups as well as within age, sex, and limited socioeconomic groups for the total sample.

The sample was drawn jointly with the U.S. Bureau of the Census, beginning with the 1960 decennial census list of addresses and the nearly 1,900 PSU's into which the entire United States was divided. Each PSU is either a standard metropolitan statistical area, a county, or a group of two or three contiguous counties. These PSU's were grouped into 40 strata so that each stratum had an average size of about 4.5 million persons, and the grouping was done so as to maximize the degree of homogeneity within strata with regard to the population size of the PSU's, degree of urbanization, geographic proximity, and degree of industrialization. The 40 strata were then classified into four broad geographic regions of 10 strata each and next cross-classified within each region by four population density classes and classes of rate of population change from 1950 to 1960. Using a modified Goodman-Kish controlled-selection technique, one PSU was drawn from each of the 40 strata.

Generally, within each PSU, 20 ED's were selected with the probability of selection of a particular ED proportional to its population in the age group 5-9 years in the 1960 Census, which by 1966 approximated the target population for Cycle III. A similar method was used for selecting one segment (a smaller cluster of households) in each ED. Because of the approximately 3-year time interval between Cycle II and Cycle III, the Cycle III sampling frame was updated for new construction and to compensate for segments where housing was partially or totally demolished to make room for highway construction or urban redevelopment. Each of the resulting 20 segments within a PSU was either a bounded area or a cluster of households (or addresses). All the youths in the appropriate age range who resided at the address visited were eligible youths, i.e., those eligible for inclusion in the sample. Operational considerations made it necessary to reduce the number of prospective examinees at any one location to a maximum of 200. When the number of eligible youths

in a particular location exceeded this number, the "excess" eligible youths were deleted from the sample through a systematic sampling technique. Youths who were not selected as sample persons in the Cycle III sample but who had previously been examined in Cycle II were scheduled for examination if time permitted and will be included in special longitudinal analyses. Individual twins who were deleted from the Cycle III sample were also scheduled for examination, as in Cycle II, to provide data on pairs of twins for future analysis. These data are not included in this report as part of the national probability sample of youths.

The sample was selected in Cycle III, as it had been for the children in Cycle II, so as to contain proportional representation of youths from families having only one eligible youth, two eligible youths, and so on, thus making the sample representative of the total target population. However, since households were one of the elements in the sample frame, the number of related youths in the resulting sample was greater than would result from a design which sampled youths 12-17 years without regard to household. The resulting estimated mean measurements or rates should be unbiased, but their sampling variabilities are somewhat greater than those from a more costly, time-consuming, systematic sample design in which every k^{th} youth would be selected.

The total probability sample for Cycle III included 7,514 youths representative of the approximately 22.7 million noninstitutionalized U.S. youths of 12-17 years. The sample contained youths from 25 different States, with approximately 1,000 in each single year of age.

Table I. Number of examinees who were scored on the Wide Range Achievement Test and estimated frequencies for the noninstitutionalized population of the United States, by age and sex: Health Examination Survey, 1966-70

Age in years and months	Both sexes			Boys			Girls		
	Total	Scored[1]	Not scored[2]	Total	Scored[1]	Not scored[2]	Total	Scored[1]	Not scored[2]
	Number of examinees in sample								
12-0 to 17-11-----	6,768	6,756	12	3,545	3,538	7	3,223	3,218	5
12-0 to 12-5---	544	544	-	287	287	-	257	257	-
12-6 to 12-11--	646	646	-	356	356	-	290	290	-
13-0 to 13-5---	637	636	1	327	326	1	310	310	-
13-6 to 13-11--	571	570	1	299	299	-	272	271	1
14-0 to 14-5---	611	607	4	305	303	2	306	304	2
14-6 to 14-11--	593	591	2	313	312	1	280	279	1
15-0 to 15-5---	562	561	1	321	320	1	241	241	-
15-6 to 15-11--	554	553	1	292	292	-	262	261	1
16-0 to 16-5---	566	566	-	295	295	-	271	271	-
16-6 to 16-11--	526	526	-	261	261	-	265	265	-
17-0 to 17-5---	473	473	-	242	242	-	231	231	-
17-6 to 17-11--	485	483	2	247	245	2	238	238	-
	Population estimates in thousands								
12-0 to 17-11-----	22,692	22,652	40	11,489	11,464	25	11,203	11,188	15
12-0 to 12-5---	1,842	1,842	-	911	911	-	931	931	-
12-6 to 12-11--	2,160	2,160	-	1,121	1,121	-	1,039	1,039	-
13-0 to 13-5---	2,100	2,097	3	1,075	1,072	3	1,025	1,025	-
13-6 to 13-11--	1,852	1,849	3	931	931	-	921	918	3
14-0 to 14-5---	1,950	1,933	17	974	963	11	976	970	6
14-6 to 14-11--	1,902	1,896	6	977	974	3	925	922	3
15-0 to 15-5---	1,860	1,857	3	985	982	3	875	875	-
15-6 to 15-11--	1,891	1,888	3	915	915	-	976	973	3
16-0 to 16-5---	1,914	1,914	-	997	997	-	917	917	-
16-6 to 16-11--	1,711	1,711	-	839	839	-	872	872	-
17-0 to 17-5---	1,759	1,759	-	879	879	-	880	880	-
17-6 to 17-11--	1,751	1,746	5	885	880	5	866	866	-

[1]Includes estimates for missing data shown in table II.
[2]No estimates made, since tests were not done because of factors attributable to the sample youths (blindness, physical disability, etc.).

The response rate in Cycle III was 90 percent, with 6,768 youths examined out of the total sample. These examinees were closely representative of those in the population from which the sample was drawn with respect to age, sex, race, region, and population density and growth in area of residence. Hence it appears unlikely that nonresponse could bias the findings appreciably.

Reliability

While measurement processes in the surveys were carefully standardized and closely controlled, the correspondence between true population figures and survey results cannot be expected to be exact. Survey data are imperfect for three major reasons: (1) results are subject to sampling error, (2) the actual conduct of a survey never agrees perfectly with the design, and (3) the measurement processes themselves are inexact even though standardized and controlled.

Data recorded for each sample youth are inflated in the estimation process to characterize the larger universe of which the sample youths are representative. The weights used in this inflation process are a product of the reciprocal of the probability of selecting the youth, an adjustment for nonresponse cases, and a poststratified ratio adjustment which increases precision by bringing survey results into closer alignment with known U.S. population figures by color and sex within single years of age 12-17.

In the third cycle of the Health Examination Survey (as in Cycle II) the sample was the result of three principal stages of selection—the single PSU from each stratum, the 20 segments from each sample PSU, and the sample youth from the eligible youths. The probability of selecting an individual youth is the product of the probability of selection at each stage.

Since the strata are roughly equal in population size and a nearly equal number of sample youths were examined in each of the sample PSU's, the sample design is essentially self-weighting with respect to the target population; that is, each youth 12-17 years of age had about the same probability of being drawn into the sample.

The adjustment upward for nonresponse is intended to minimize the impact of nonresponse on final estimates by imputing to nonrespondents the characteristics of "similar" respondents. Here "similar" respondents are judged to be examined youths in a sample PSU having the same age in years and sex as youths not examined in that sample PSU.

The poststratified ratio adjustment used in the third cycle achieved most of the gains in precision which would have been attained if the sample had been drawn from a population stratified by age, color, and sex and makes the final sample estimates of population agree exactly with independent controls prepared by the U.S. Bureau of the Census for the noninstitutionalized population as of March 9, 1968 (approximate midsurvey point for Cycle III) by color and sex for each single year of age 12-17. The weight of every responding sample youth in each of the 24 age, color, and sex classes is adjusted upward or downward so that the weighted total within the class equals the independent population control. Final sample frequencies and estimated population frequencies as of the approximate midsurvey point are presented in table I by age and sex.

Table II. Number of missing or unusable reading and arithmetic subtests of the Wide Range Achievement Test, by age and sex of examinee: Health Examination Survey, 1966-70

Age	Both sexes	Boys	Girls
	Reading		
12-17 years	181	109	72
12 years	36	25	11
13 years	32	18	14
14 years	36	24	12
15 years	28	21	17
16 years	20	7	13
17 years	29	14	15
	Arithmetic		
12-17 years	198	123	75
12 years	41	29	12
13 years	34	21	13
14 years	43	30	13
15 years	28	19	9
16 years	24	10	14
17 years	28	14	14

Extent of Missing Test Results and Imputation Procedures

In addition to youths who were selected for the sample but, for various reasons, not examined, there were some whose examination was incomplete in one procedure or another. The extent of missing data for the WRAT is shown in table II according to sex and age. For 181 youths, or 2.7 percent of all those examined, the WRAT reading subtest results were not available. The WRAT arithmetic subtest results were not available for 198 youths, or 2.9 percent of all those examined. There were a number of reasons for this missing data, primarily operational and logistical survey problems such as lost records or lack of time to complete the examination. Since the reason for missing test results in most cases was not directly related to the characteristic being measured, raw scores were imputed for almost all of these examinees. In certain infrequent instances imputation was not considered ap-

propriate, as for example the imputation of reading scores for a blind youth or for a foreign-language speaking youth who could not understand English well enough to take any of the psychological tests.

Imputation was accomplished in the following manner. An intercorrelation matrix of data collected during the survey, including all psychological test scores and selected socioeconomic items, was derived to identify those variables which were most highly associated with each raw test score. As a result, five variables were chosen for the imputation of reading and arithmetic raw scores: other available test scores, educational level of the head of the household (four categories), age, and two control variables—race and sex. Imputation of a missing test result for an examinee was accomplished by randomly selecting a match among the group of examinees with the same age in years, parental level of education, race, sex, and available raw score test results most highly correlated with the scores to be imputed. The raw score of this "matched" examinee was then imputed to the examinee with the missing score. When data for any of these variables were not available, a match was selected using information on as many of the variables as were available in the youth's record.

Sampling and Measurement Error

In the present report, reference has been made to efforts to minimize bias and variability of measurement techniques. The probability design of the survey makes possible the calculation of sampling errors. The sampling error is used here to determine how imprecise the survey test results may be because they result from a sample rather than from the measurement of all elements in the population. The estimation of sampling errors for a study of the type of the Health Examination Survey is difficult for at least three reasons: (1) measurement error and "pure" sampling error are confounded in the data, and it is difficult to find a procedure which will either completely include both or treat one or the other separately, (2) the survey design and estimation procedure are complex and accordingly require computationally involved techniques

Table III. Standard errors of mean reading scores on the Wide Range Achievement Test for youths, by sex, age, and educational level: United States, 1966-70

Sex and age	All levels	Grade in school									High school graduate	More than high school education	Left high school before graduating	Special placement
		4 and below	5	6	7	8	9	10	11	12				
Both sexes														
12-17 years-	0.42	4.08	1.42	1.10	0.53	0.40	0.54	0.53	0.42	0.63	1.68	2.71	1.03	1.12
12 years--	0.37	4.97	1.18	1.21	0.46	1.23	*	-	-	-	-	-	-	1.24
13 years--	0.44	*	3.87	1.12	1.68	0.47	0.97	*	*	-	-	-	-	1.54
14 years--	0.58	*	*	3.31	1.27	1.05	0.52	1.21	*	*	-	*	*	3.66
15 years--	0.66	-	*	*	2.88	2.18	1.18	0.66	1.50	*	*	*	*	*
16 years--	0.41	*	*	-	*	2.73	1.18	1.20	0.44	1.49	*	*	1.86	*
17 years--	0.71	-	-	-	*	*	2.02	1.72	1.13	0.63	1.79	2.89	0.89	*
Boys														
12-17 years-	0.50	6.02	1.55	1.19	0.79	0.55	0.57	0.67	0.61	0.78	1.85	1.85	1.67	1.43
12 years--	0.56	6.46	1.43	1.30	0.68	1.51	*	-	-	-	-	-	-	1.94
13 years--	0.64	*	4.74	1.92	2.23	0.65	1.11	*	-	-	-	-	-	2.84
14 years--	0.78	*	*	2.90	1.62	1.26	0.58	1.83	-	*	-	-	*	6.58
15 years--	0.73	-	-	*	2.40	2.07	0.96	0.78	2.22	*	*	-	*	*
16 years--	0.76	-	-	-	*	2.84	1.72	1.27	0.73	1.52	-	*	2.98	*
17 years--	0.91	-	-	-	*	*	1.33	1.91	1.38	0.80	1.91	2.14	1.40	*
Girls														
12-17 years-	0.40	4.98	2.11	1.25	0.54	0.54	0.72	0.60	0.61	0.96	2.35	4.25	1.09	1.39
12 years--	0.50	7.72	2.42	1.37	0.56	1.87	-	-	-	-	-	-	-	1.70
13 years--	0.50	*	8.43	1.17	1.43	0.53	1.24	*	*	-	-	-	-	5.21
14 years--	0.59	*	-	8.45	1.60	1.10	0.72	1.21	*	-	-	-	*	*
15 years--	0.76	-	*	*	11.62	3.79	1.87	0.68	1.19	*	*	-	*	*
16 years--	0.48	*	*	-	*	18.30	2.21	1.62	0.62	1.94	*	*	2.02	*
17 years--	0.81	-	-	-	*	-	15.50	3.78	1.52	0.95	2.50	4.23	1.76	*

Table IV. Standard errors of mean arithmetic scores on the Wide Range Achievement Test for youths, by sex, age, and educational level: United States, 1966-70

Sex and age	All levels	Grade in school								High school graduate	More than high school education	Left high school before graduating	Special placement
		4 and below	5	6	7	8	9	10	11	12				
Both sexes														
12-17 years	0.26	1.48	0.76	0.55	0.34	0.28	0.29	0.32	0.27	0.29	1.33	1.10	0.44	0.50
12 years	0.23	2.17	0.71	0.52	0.25	0.61	*	-	-	-	-	-	-	0.45
13 years	0.29	*	2.21	1.04	0.87	0.23	0.42	*	*	-	-	-	-	1.16
14 years	0.35	*	*	1.36	0.46	0.74	0.33	0.60	*	*	-	-	*	1.86
15 years	0.33	*	*	*	1.77	1.46	0.68	0.30	0.73	*	*	-	*	*
16 years	0.31	*	*	-	*	1.45	0.86	0.73	0.30	0.56	*	*	0.96	*
17 years	0.36	-	-	-	*	* *	1.62	0.71	0.51	0.39	1.38	1.19	0.52	*
Boys														
12-17 years	0.27	1.84	0.64	0.60	0.40	0.36	0.27	0.40	0.27	0.45	1.57	2.41	0.91	0.63
12 years	0.30	3.14	3.14	0.57	0.31	0.61	*	-	-	-	-	-	-	0.79
13 years	0.38	*	7.34	1.30	1.07	0.35	0.64	*	-	-	-	-	-	1.52
14 years	0.42	*	*	1.84	0.55	0.88	0.43	1.06	-	*	-	-	*	*
15 years	0.32	*	-	*	1.64	1.14	0.55	0.37	1.02	*	*	-	*	*
16 years	0.39	-	-	-	*	*	1.10	0.76	0.36	1.07	-	*	1.13	*
17 years	0.44	-	-	-	*	*	*	1.06	0.67	0.56	1.70	2.55	0.80	*
Girls														
12-17 years	0.27	2.22	1.29	0.58	0.34	0.33	0.41	0.32	0.47	0.40	1.46	1.61	0.52	0.90
12 years	0.23	3.07	1.47	0.61	0.31	0.96	-	-	-	-	-	-	-	1.00
13 years	0.32	*	5.52	0.81	0.76	0.29	0.47	7.77	*	-	-	-	-	3.01
14 years	0.39	*	-	*	1.05	0.70	0.43	0.92	10.78	-	-	-	*	*
15 years	0.42	-	*	*	6.70	2.71	1.01	0.32	0.87	*	*	-	*	*
16 years	0.32	*	*	-	*	*	1.44	0.89	0.52	0.79	*	*	1.27	*
17 years	0.46	-	-	-	*	-	*	*	0.85	0.46	1.53	1.59	1.02	*

for the calculation of variances, and (3) thousands of statistics are derived from the survey, many for subclasses of the population for which the number of sample cases is small. Estimates of sampling error are obtained from the sample data and are themselves subject to sampling error, which may be large when the number of cases in a cell is small or occasionally even when the number of cases is substantial.

Estimates of approximate sampling variability for selected statistics used in this report are included in the detailed tables and in tables III and IV. These estimates, called standard errors, have been prepared by a replication technique which yields overall variability through observation of variability among random subsamples of the total sample. The method reflects both "pure" sampling variance and a part of the measurement variance, and is described in previously published reports.[16,17]

Hypothesis Testing

In accordance with usual practice, the interval estimate for any statistic was considered to be the range within one standard error of the tabulated statistic with 68-percent confidence and the range within two standard errors of the tabulated statistic with 95-percent confidence. The latter is used as the level of statistical significance in this report.

An approximation of the standard error of a difference $d = x - y$ of two statistics x and y is given by the formula $s_d = (s_x^2 + s_y^2)^{1/2}$ where s_x and s_y are the sampling errors, respectively, of x and y. Of course, where the two groups or measures are positively or negatively correlated, this formula will give an overestimate or underestimate of the actual standard error.

Thus the procedure used in this report for testing the significance of difference between means consisted of dividing the difference between the two means by the standard error of the difference as computed above. If the magnitude of t was greater than 2.00, the difference was considered statistically significant at approximately the 5-percent confidence level. For example, the mean reading raw score for 12-year-old boys was 41.1, while the mean for 12-year-old girls was 43.1—a difference of 2.0. The approximate standard error of the difference between means was .75. Since the dif-

ference between the means was 2.7 times the standard error, the difference was considered significant beyond the 5-percent confidence level.

Small Categories

In some tables averages are shown for cells for which the sample size is so small that the relative standard error may exceed .25, a generally accepted standard for NCHS publications. Such statistics are included in this report along with their corresponding standard errors in the belief that the information, while not meeting strict standards of precision, may lend an overall impression of the survey findings and may be of interest to subject matter specialists.

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APPENDIX III

INSTRUCTIONS FOR ADMINISTRATION OF THE WIDE RANGE ACHIEVEMENT TEST FOR THE HEALTH EXAMINATION SURVEY, CYCLE III

WIDE RANGE ACHIEVEMENT TEST
ARITHMETIC INSTRUCTIONS

LOOK AT EACH PROBLEM CAREFULLY TO SEE WHAT YOU ARE SUPPOSED TO DO - ADD, SUBTRACT, MULTIPLY OR DIVIDE YOU MAY DO YOUR FIGURING IN THIS SPACE (point), BUT BE SURE TO PUT YOUR ANSWERS ON OR BELOW THE LINES (point) SKIP ANY PROBLEMS THAT ARE TOO HARD FOR YOU YOU HAVE TEN MINUTES BEGIN NOW.

If the S is unable to correctly solve at least any five problems, administer the oral parts according to the instructions outlined below

COUNTING: With the page turned so that the dots are closest to the S, point to the dots and say:

POINT WITH YOUR FINGER AND COUNT THESE DOTS ONE BY ONE BEGINNING HERE (Examiner's right) COUNT THEM OUT LOUD AND TELL ME HOW MANY THERE ARE

Occasionally a S will read the numbers below and begin counting the dots To avoid confusion, cover the digits (3, 5, etc) while the S counts the dots

READING: Point to the numbers (right side up to the S) and say:

READ THESE NUMBERS WHAT IS THIS? (pointing to the 3) AND THIS? etc

SOLVING:

IF YOU HAVE THREE PENNIES AND SPEND ONE OF THEM, HOW MANY HAVE YOU LEFT?

HOW MANY ARE THREE APPLES AND FOUR APPLES?

JACK HAD NINE MARBLES HE LOST THREE OF THEM HOW MANY WERE LEFT?

Scoring:

Oral part -	Counts 1-5	1 point
	Counts 6-15	1 point
	Reads 5 numbers, 1 point each	5 points
	Solves 3 problems, 1 point each	3 points

Written part - Score 1 point for each correct answer, use the scoring Key-Level II, as the guide In order for an answer to be correct it must match this key

WRAT - READING

LOOK AT EACH WORD CAREFULLY AND SAY IT ALOUD BEGIN HERE (point) AND READ THE WORDS ACROSS THE PAGE SO I CAN HEAR YOU WHEN YOU FINISH THE FIRST LINE, GO ON TO THE NEXT

If the Subject obtains a score of 10 points or less in the regular reading part, he should be asked to name the 13 capital letters printed above the word list and to name 2 letters in his name. Each letter is equal to one point

READ THESE LETTERS ALOUD. WHAT IS THIS? (or) WHAT DO YOU CALL THIS?

The examiner controls speed of reading by saying NEXT, or GO ON TO THE NEXT WORD at the end of 10 second time limit

Testing limits: 12 consecutive failures

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